

PROLONGED VENTRICULAR BYPASS WITH INTRATHORACIC PUMPS

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At present, we believe that in clinical application, it is preferable to use the technique of bypass of both ventricles rather than total heart replacement. We support this point for the following reasons. The durability of plastic materials for attempting a permanent substitution has not been completely explored. The intrathoracic pumps for ventricular bypass may function as long as a prosthesis for heart replacement. An external source of power is required. It leaves a reduced ventricular function with intact nervous connections for a compensatory chamber for the variable input and thus improving any possible imperfection of artificial prosthesis. Also, trauma to blood cells is minimized. With the heart in fibrillation, normal coronary arterial pressure during bypass functioning was demonstrated. The bypass technic is simple, not requiring the use of cardiopulmonary bypass during insertion. The patient's family probably would consent more readily to this technique than to total extirpation of the heart, thus relieving the surgeon of a stressful social and ethical problem.

Figure 1 shows the left ventricular bypass prepared for clinical use. It is placed against the chest wall thus avoiding any compression of the lung. The connection for measuring atrial pressure is shown at a. and the connection for the pump's heparinization, in order to avoid clotting if bypass is discontinued for observation, is shown at b. Figure 2. shows the double ventricular bypass. The outlet connection for the left ventricle can be placed in either the ascending or descending thoracic aorta, depending upon the prepared surgical exposure. Figure 3 shows the various possibilities, once the double bypass is working: a. leaving the heart intact, b. allowing partial resection of left ventricle, c. total ventricular extirpation.

All plastic materials are placed in a high blood flow, but none inside atrial cavities, in order to avoid thrombotic phenomena. In this situation the pump could be compared to an arterial graft. This is accomplished with a silastic external atrial connection sutured to the external atrial wall (Figure 4 a-b), allowing the removal in the center of a large disc of atrial wall (Figure 4c). The suture line is made air-tight using Eastman glue. Emphasis is placed upon the importance of an adequate inlet connection in the pump's performance.

The pump's input and atrial pressure combine to command the function of the entire bypass system. The external wall of the intrathoracic pump collapses proportionally to the decrease of the pump's input, thus avoiding suction in the atrial cavities. On the other hand, the pump's rate rises progressively from 85 to 110-120 if atrial pressure rises above 15 mm. Hg and decreases to 20-30 if atrial pressure falls below zero. Consequently, the function of the intrathoracic pump is almost discontinued with reduced input and if atrial pressure drops below zero. It resumes complete function with a positive atrial pressure of 5 mm. Hg.

We believe that clinical application in irreversible heart failure during heart surgery is the necessary step to get experience in this field with subsequent improvement of present designs.

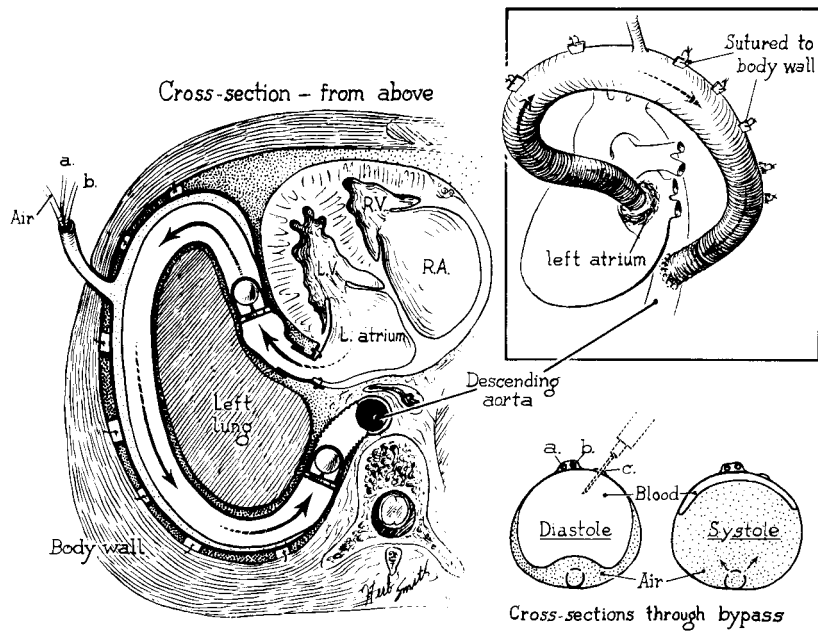


Figure 1. Left ventricular bypass.

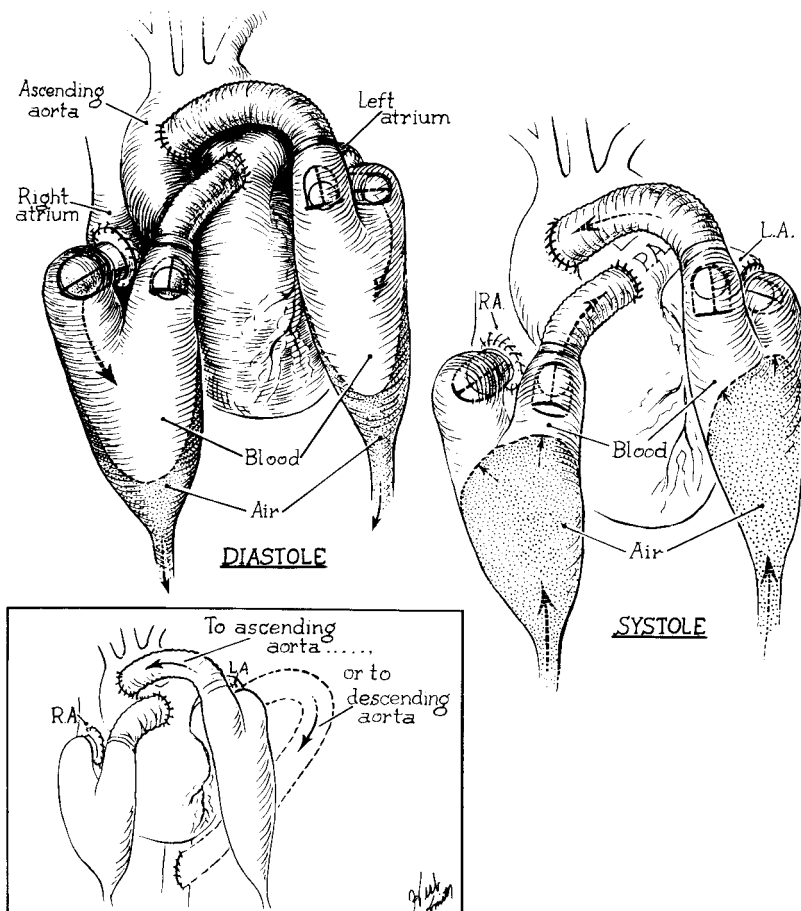


Figure 2. Double ventricular bypass.

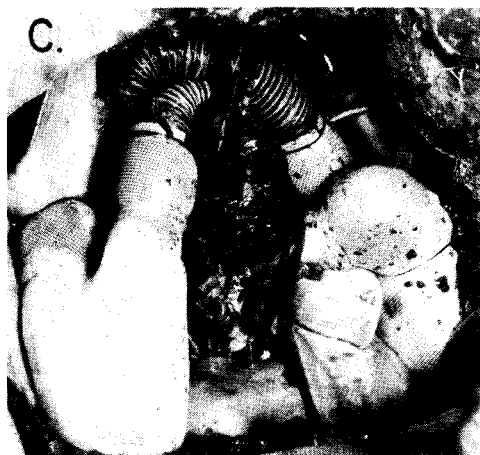
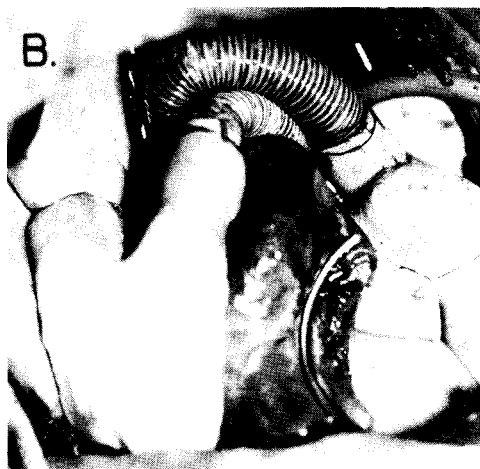
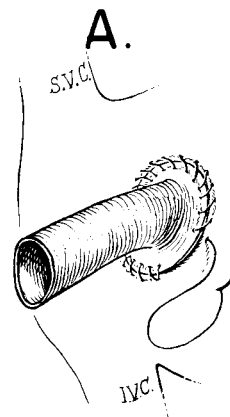
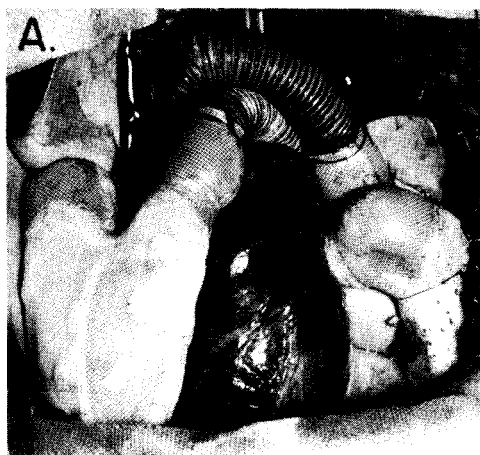


Figure 3. Possibilities once double ventricular bypass is working.

Figure 4. External atrial connection.